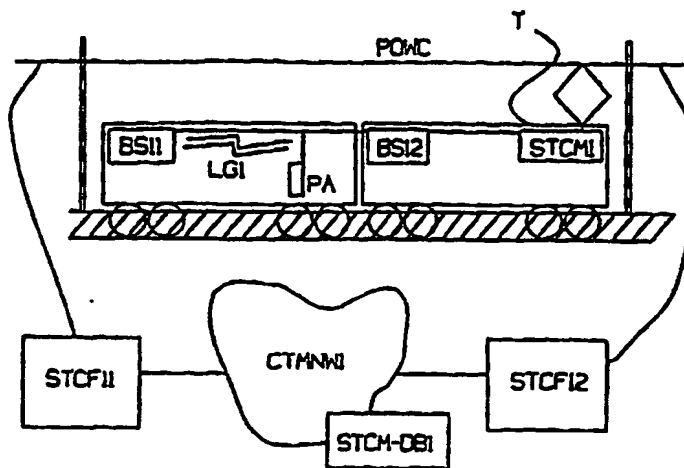




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/SE97/02013 <b>(22) International Filing Date:</b> 1 December 1997 (01.12.97) <b>(30) Priority Data:</b> 9604492-0      5 December 1996 (05.12.96)      SE <b>(71) Applicant (for all designated States except US):</b> TELEFON-AKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> HALLENSTÅL, Magnus [SE/SE]; Täbyvägen 220, S-183 Täby (SE). <b>(74) Agent:</b> TELEFONAKTIEBOLAGET LM ERICSSON; Patent and Trademark Dept., S-126 25 Stockholm (SE).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Swedish).</i>

**(54) Title:** DEVICE AND METHOD FOR A TELECOMMUNICATIONS SYSTEM



**(57) Abstract**

The present invention relates to a device and a method for communication in a means of conveyance by a cordless telecommunication system, particularly by a DECT (Digital European Cordless Telephony)-based CTM (Cordless Terminal Mobility)-system. The device comprises at least one mobile base station (BS11, BS12, BS) and a mobile transceiver (STCM1, STCM2), both mounted on a means of conveyance (T, B). The device is further disposed to be able to communicate, on the one hand, with a portable subscriber unit (PA) on or in the means of conveyance (T, B) and compatible with the cordless telecommunication system (CTM1) via an air interface (LGI) and, on the other hand, with the cordless telecommunication system (CTM1) via a fixed connection (POWC, STCF11, STCF12), which preferably includes an existing power cable (POWC) or conductor rail, or via a cellular network (GSMNW), particularly of the type GSM.

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## DEVICE AND METHOD FOR A TELECOMMUNICATIONS SYSTEM

## TECHNICAL FIELD

The present invention relates to a device and a process for communication in a means of conveyance for a cordless telecommunication system, particularly a DECT (Digital European Cordless Telephony)-based CTM (Cordless Terminal Mobility)-system.

## RELATED TECHNOLOGY

One problem with cordless telecommunication systems, such as e.g. DECT-based CTM-systems, is that only user-dense areas can be covered at reasonable cost, and this means that there will be islands with CTM-coverage. Furthermore, DECT-radio waves can be easily blocked by obstacles such as buildings and vehicles due, on the one hand, to low transmission power and, on the other hand, to the radio frequency used.

When subscribers happen to be outside the islands of CTM-coverage, e.g. on a public means of conveyance such as a train or in a bus, they can not use their portable subscriber units, such as cordless telephones, for example. Even within these islands of coverage, the above mentioned shadow effects can occur, especially in an underground train but also in buses and trains, if the distance to the closest radio-based station is long.

One solution to the above mentioned problems is to use a telephone of "dual mode"-type, which automatically switches between DECT and a cellular net such as a net of the type GSM (Global System for Mobile Communication). The problems with this method is that the telephones become complicated and expensive. It can also be necessary to have two different subscriptions with two different operators.

Another solution is to couple together a mobile DECT-system with a cellular net, e.g. a GSM-system, as described in US 5,384,824. This publication deals with positional updating of the mobile DECT-system in the GSM-system. The DECT-system also comprises i.a. protocol conversion between the DECT- and the GSM-systems.

5

## DESCRIPTION OF THE INVENTION

The purpose of the present invention is to achieve a device and a process for making it possible to use a portable subscriber unit in a cordless telecommunication system, particularly in a DECT-based CTM-system, in a means of conveyance such as a  
10 train, an underground train, a streetcar or a bus, even when outside the islands of radio coverage or in a radio shadow.

This is achieved by a mobile device on the means of conveyance, said mobile device being disposed to communicate with the cordless telecommunication system.

15

The device comprises according to the invention at least one mobile base station and a mobile transceiver, both mounted on the means of conveyance. The device is further arranged to be able to communicate both with a portable subscriber unit on the means of conveyance and compatible with the cordless telecommunication system via an air interface and with the cordless telecommunication system.

20

If the means of conveyance is a means of conveyance driven by a power cable or a conductor rail, the invention is preferably implemented in such a way that the device is arranged to communicate with the cordless telecommunication system via  
25 the existing power cable or conductor rail and via fixed transceivers placed along the path of the means of conveyance.

25

If the means of conveyance is motor-driven, the invention is preferably implemented so that the device is arranged to communicate with the cordless telecommunication system via a cellular net, such as e.g. a network of the type GSM.

30

One advantage of the invention is that a subscriber with a portable subscriber unit in a means of conveyance can communicate with the cordless telecommunication system even outside the islands of radio coverage or in a radio shadow.

5

An additional advantage of the invention is that a common portable subscriber unit such as a cordless telephone can be used.

Still another advantage of the invention is that the subscriber only needs one subscription.

10

#### DESCRIPTION OF THE FIGURES

The invention will be described in more detail below with reference to the accompanying drawing, which only illustrates the invention and therefore in no way limits the invention.

15

Fig. 1 shows a device for a CTM-system, according to the invention, with mobile base stations placed on an electrically driven train and where communication takes place with the CTM-system via the existing power cable.

20

Fig. 2 shows a device for a CTM-system, according to the invention, with a mobile base station placed in a bus and where communication takes place with the CTM-system via an existing cellular net.

#### 25 PREFERRED EMBODIMENTS

The invention is described substantially with reference to two different preferred embodiments providing ways for a subscriber in a cordless telecommunication system, such as a DECT-based CTM-net CTMNW1, CTMNW2, to use his portable subscriber unit PA in a means of conveyance, especially a public means of conveyance such as e.g. a train T, an underground train, a streetcar or a bus B.

30

Both solutions are based on having at least one base station BS11, BS12, BS connected to at least one mobile transceiver STCM1, STCM2, both mounted inside or on the means of conveyance T, B. The base station BS11, BS12, BS and the mobile transceiver STCM1, STCM2 are thus mobile.

The mobile base station BS11, BS12, BS is arranged to communicate via an air interface LG1 with the portable subscriber unit PA. The mobile transceiver STCM1, STCM2 is arranged to communicate with the cordless telecommunication system CTM1, CTM2.

The two different embodiments will be described in more detail below.

1. Mobile base station BS11, BS12 and mobile transceiver STCM1 in a means of conveyance T driven via a power cable POWC or a conductor rail, with communication with the telecommunication system CTM1 via a fixed link.

2. Mobile base station BS and mobile transceiver STCM2 in a motor-driven means of conveyance B with communication with the telecommunication system CTM2 via a second air interface LG2 and a cellular net GSMNW.

#### **Communication with fixed link**

Fig. 1 shows a CTM-network CTM1 with mobile base stations BS11, BS12 placed in an electrically driven train T and where communication takes place with the CTM-network CTM1 via a fixed link which can comprise an existing power cable POWC for the train T. An alternative is to arrange a separate cable for communication, parallel to, and in particular in conjunction with said power cable POWC.

The base stations BS11, BS12 are connected to a portable or mobile transceiver STCM1, which in turn is connected to the power cable POWC. When the train T is in motion, the mobile transceiver STCM1 will move into the areas of coverage for the different fixed transceivers disposed along the track and connected to the power cable POWC. Two of these fixed transceivers STCF11, STCF12 are shown in Fig. 1. The fixed transceivers STCF11, STCF12 are connected to the CTM-network CTMNW1.

The network CTMNW1 is continuously informed as to where each mobile transceiver STCM1 is at the moment, for example, in a manner similar to the way a cellular net is informed of the whereabouts of each mobile telephone. This means that the network CTMNW1 requires a data base STCM-DB1, where the current position for each mobile transceiver STCM1 is stored.

When a portable subscriber unit PA is brought in by so-called roaming or is activated within the coverage area for a base station, e.g. BS11, the base station will report this to the mobile transceiver STCM1, which will in turn report to the network CTMNW1 that the portable subscriber unit PA is activated and presently is within the coverage area of the mobile transceiver STCM1, in other words that the portable subscriber unit PA is linked to the mobile transceiver STCM1 and to the network CTMNW1.

If the portable subscriber unit PA is brought into the coverage area for a second base station BS12 which belongs to the same mobile transceiver STCM1, this will be reported to the mobile transceiver STCM1, but no further, i.e. the network CTMNW1 will not be informed.

If an incoming call comes to the portable subscriber unit PA, the network CTMNW1 will first search in a data base as to where the portable subscriber unit PA is to be found. In the present case, the answer given will be that the portable

subscriber unit PA is in an area which is covered by a mobile transceiver STCM1. This will involve an additional data search; this time in the data base STCM-DB1 to determine under which fixed transceiver STCF11, STCF12 the mobile transceiver STCM1 is located. The network CTMNW1 finds that it is the fixed transceiver  
5 STCF11 and has sufficient information to set up the call. A connection to the fixed transceiver STCF11 is set up, and the fixed transceiver STCF11 then makes a connection to the mobile transceiver STCM1 and orders it to search for the portable subscriber unit PA by so-called paging. The call then continues in the conventional manner. When the call is terminated, the entire connection is disconnected. For out-  
10 going calls, the mobile transceiver STCM1 must set up the connection to the fixed transceiver STCF11. Otherwise the call connection is done in the conventional manner.

The CTM-network CTMNW1 described above is completely interchangeable with  
15 other cordless telecommunication systems, such as e.g. a system of the type PHS (Personal Handyphone System).

The fixed connection between the fixed transceivers STCF11, STCF12 and the CTM-network CTMNW1 can, for example, consist of or comprise the public fixed  
20 telenet PSTN or leased lines.

### **Communication via a cellular network**

Buses or other motor-driven means of conveyance have, of course, no existing power cable or conductor rail for power transmission. In these cases, a cellular net-  
25 work can be used to set up a connection between a mobile transceiver and fixed transceivers. This can be implemented by an arrangement in which the mobile transceiver is arranged to operate as one or more mobile telephones, and the fixed transceivers are arranged to operate as radio base stations.



It is also conceivable to use an existing GSM-net to set up a connection between the mobile transceiver and the CTM-network. The existing radio base stations are thus used and there is no need for fixed transceivers. In the following, such an arrangement will be described in more detail. References to GSM should only be taken as examples; it is fully interchangeable with any other type of cellular network, e.g. a network of the type NMT (Nordic Mobile Telephony), TACS (Total Access Communication System), AMPS (Advanced Mobile Phone System) or ADC (American Digital Cellular).

Fig. 2 shows a CTM-network CTM<sub>NW2</sub> with a mobile base station BS placed in a bus B and where communication takes place via an existing GSM-network GSM<sub>NW</sub>. The base station BS is connected to a mobile transceiver STCM<sub>2</sub> which is arranged to act as a number of different GSM-mobile subscriber units. Each of these fictitious subscriber units preferably has a GSM-telephone number GSMNR<sub>1</sub>, GSMNR<sub>2</sub>, GSMNR<sub>3</sub>, i.e. with each fictitious subscriber unit there is associated a GSM-subscription. At least one of these GSM-telephone numbers GSMNR<sub>1</sub> or possible connections is used only for signalling between the mobile transceiver STCM<sub>2</sub> and the CTM-network CTM<sub>NW2</sub>. The other mobile telephone numbers GSMNR<sub>2</sub>, GSMNR<sub>3</sub> are disposed to be used for calls. In this manner, the GSM-network GSM<sub>NW</sub> will be completely transparent, i.e. from the point of view of the GSM-network GSM<sub>NW</sub>, these mobile subscription units can be treated as all other mobile subscription units belonging to the network GSM<sub>NW</sub>.

If the GSM-network GSM<sub>NW</sub> comprises data communication channels, for example, of the type which is defined in GPRS (General Packet Radio Services), such a data communication channel can instead be used with advantage for signalling.

In the CTM-network there is a data base STCM-DB<sub>2</sub> in which there is stored for each mobile transceiver a list of the GSM-telephone numbers allotted to the mobile transceiver and which is used for signalling and which are free for calls. In the data

base STCM-DB2 there are also stored for each mobile transceiver the portable subscription units which are connected thereto at that time.

When a portable subscriber unit PA is brought into or is activated within the range  
5 of coverage of the mobile base station, the mobile transceiver STCM2 will use the  
above described signalling connection to communicate with the CTM-network  
CTMNR2 and the data base STCM-DB2 specified therein. For the mobile trans-  
ceiver STCM2 there is in the data base STCM-DB2 a list STCM2-R with a GSM-  
telephone number GSMNR1 for signalling and a number of GSM-telephone num-  
10 bers GSMNR2, GSMNR3 for calls. If data communication channels are available,  
one is used for signalling, and the GSM-telephone number GSMNR1 is available  
for calls.

If an incoming call comes to the portable subscriber unit PA which is connected to  
15 the mobile transceiver STCM2, the CTM-network CTMNR2 selects the GSM-  
signalling connection intended for this purpose, i.e. its GSM-telephone number  
GSMNR1 in the list STCM2-R, or the data communication channel. The CTM-  
network CTMNR2 signals via the allocated signalling connection to the mobile  
transceiver STCM2, which forwards the information to the base station BS, which  
20 in turn seeks the portable subscriber unit PA. When the portable subscriber unit PA  
is found, a speech channel is set up between the CTM-network CTMNR2 and the  
mobile transceiver STCM2 in the bus B. From the list STCM2-R, the GSM-tele-  
phone number is taken, which the CTM-network CTMNR2 is to use for setting up  
a connection to the mobile transceiver STCM2.

25 When a portable subscriber unit PA, which has been brought into the area of cover-  
age for a mobile base station BS in a bus B, wishes to make a call and dials a num-  
ber, the mobile transceiver STCM2 will signal to the CTM-network CTMNR2 via  
the signalling connection and request that a call be set up between the mobile trans-  
30 ceiver STCM2 and the CTM-network CTMNR2 using one of the GSM-conne-

tions, i.e. one of the available telephone numbers GSMNR2, GSMNR3 associated with the GSM-connections. Information concerning unengaged telephone numbers is taken from the list STCM2-R. The signalling connection will be used to send the necessary data to the CTM-network CTMNR2, from which the connection is set up. By doing this, the CTM-network can check debiting of the subscription connected to the portable subscriber unit PA and can track connections which are no longer being used.

The signalling connection is thus used to transfer information concerning call-checking, such as connecting and disconnecting speech channels and for position updates. It can also be used to transmit service data, e.g. number presentation of incoming calls.

In an additional example, the concept with the cellular net as a transmission medium is used for military purposes. One or more mobile base stations connected to one or more mobile transceivers of the above described type can be used at military installations. When a military installation is moved, the base stations and transceivers belonging to the military installation are also moved. It is also possible that satellites could be used as transmission media between transceivers or between transceivers and networks.

The advantages which the present invention has include the possibility for a CTM-subscriber to use his telephone while travelling on a means of conveyance even outside islands of radio coverage or in a radio shadow.

Furthermore, a common portable subscriber unit, such as a cordless telephone, can be used, i.e. there is no need for a "dual mode"-telephone or more than one subscription.

By using an existing power cable for communication with the network, as in the present invention, there is avoided dependence on the presence of cellular networks or access thereto.

- 5 If an existing cellular network is used, there is no effect on the same. The cellular network is only used as a transmission medium and is completely transparent. The cellular network can be owned by an arbitrary operator, from whose point of view only a number of subscriptions are given to the operator of the cordless telecommunication system.

10

The invention is, of course, not limited to the embodiments described above and shown in the drawings. Rather it can be modified within the scope of the accompanying patent claims.

**Claims**

1. Device for a cordless telecommunication system (CTM<sub>NW1</sub>, CTM<sub>NW2</sub>), especially in a DECT (Digital European Cordless Telephony)-based CTM (Cordless  
5 Terminal Mobility)-system, **characterized** in
- that it is mounted on a means of conveyance (T, B), and
  - that it is arranged to communicate, on the one hand, with a portable subscriber unit (PA) on the means of conveyance (T, B) and compatible with the cordless telecommunication system (CTM<sub>NW1</sub>, CTM<sub>NW2</sub>) via an air interface (LG1) and,  
10 on the other hand, with the cordless telecommunication system (CTM<sub>NW1</sub>, CTM<sub>NW2</sub>).
2. Device according to Claim 1, **characterized** in that it comprises at least one mobile base station (BS11, BS12, BS), connected to at least one mobile transceiver  
15 (STCM1, STCM2), whereof
- the mobile base station (BS11, BS12, BS) is arranged to communicate with the portable subscriber unit (PA), and
  - the mobile transceiver (STCM1, STCM2) is arranged to communicate with the cordless telecommunication system (CTM<sub>NW1</sub>, CTM<sub>NW2</sub>).
- 20 3. Device according to Claim 2, **characterized** in that the mobile transceiver (STCM1) is arranged to communicate with the cordless telecommunication system (CTM<sub>NW1</sub>) via a fixed connection.
- 25 4. Device according to Claim 3, **characterized** in that at least a portion of the fixed connection consists of a power cable or conductor rail (POWC) belonging to the means of conveyance (T).
- 30 5. Device according to Claim 3 or 4, **characterized** in that the mobile transceiver (STCM1) is arranged to communicate with the cordless telecommunication system

(CTMNW1) via fixed transceivers (STCF11, STCF12) placed along the path of movement of the means of conveyance.

6. Device according to Claim 5, **characterized** in that the mobile transceiver (STCM1) is arranged to inform the cordless telecommunication system (CTMNW1) as to which fixed transceiver (STCF11, STCF12) it is currently connected to.

7. Device according to one of Claims 2-6, **characterized** in that the mobile transceiver (STCM1) is arranged to inform the cordless telecommunication system (CTMNW1) as to which portable subscriber units (PA) are currently connected to it via the mobile base station (BS11, BS12).

8. Device according to Claim 2, **characterized** in that the mobile transceiver (STCM2) is arranged to communicate with the cordless telecommunication system (CTMNW2) via a cellular network (GSMNW), particularly of the type GSM (Global System for Mobile Communication).

9. Device according to Claim 8, **characterized** in that the mobile transceiver (STCM2) is arranged to request the cordless telecommunication system (CTMNW2) to set up a call in the event that a subscriber connected to the mobile transceiver (STCM2) performs a predetermined act, particularly dials a number.

10. Device according to Claim 8 or 9, **characterized** in that the mobile transceiver (STCM2) is arranged to inform the cordless telecommunication system (CTMNW2) as to which portable subscribers (PA) are currently connected to it via the mobile base station (BS).

11. Device according to one of Claims 8-10, **characterized** in that the mobile transceiver (STCM2) is arranged to act as a number of mobile subscriber units in the

cellular network (GSMNW), particularly units to which mobile telephone numbers (GSMNR1, GSMNR2, GSMNR3) are associated.

5 12. Device according to Claim 11, **characterized** in that at least one of the mobile subscriber units with associated telephone number (GSMNR1) is disposed to receive signals from and send signals to the cordless telecommunication system (CTMNW2), and that the other mobile subscriber units with associated mobile telephone numbers (GSMNR2, GSMNR3) are disposed to be used for calls.

10 13. Device according to one of Claims 8-11, **characterized** in that the mobile transceiver (STCM2) is disposed to use one data communication channel belonging to the cellular network (GSMNW) to receive signals from and send signals to the cordless telecommunication system (CTMNW2).

15 14. Device according to Claim 2, **characterized** in that the mobile transceiver (STCM2) is arranged to communicate with the cordless telecommunication system (CTMNW2) via satellite.

20 15. Method for a cordless telecommunication system (CTMNW1, CTMNW2), particularly for a DECT (Digital European Cordless Telephony)-based CTM (Cordless Terminal Mobility)-system, **characterized** in

- that a mobile base station (BS11, BS12, BS) is connected to at least one mobile transceiver (STCM1, STCM2),
- that said mobile base station (BS11, BS12, BS) and mobile transceiver (STCM1, STCM2) are arranged on a means of conveyance (T, B), and
- 25 - that said mobile base station (BS11, BS12, BS) and transceiver (STCM1, STCM2) are arranged to communicate, on the one hand, with a portable subscriber unit (PA) on the means of conveyance (T, B) and compatible with the cordless telecommunication system (CTMNW1, CTMNW2) via an air interface (LG1), and, on

the other hand, with the cordless telecommunication system (CTMNW1, CTMNW2).

- 5 16. Method according to Claim 15, **characterized** in that said mobile base station (BS11, BS12) and transceiver (STCM1) are arranged to communicate with the cordless telecommunication system (CTMNW1) via a fixed connection, particularly a fixed connection comprising a power cable or conductor rail (POWC) belonging to the means of conveyance (T).
- 10 17. Method according to Claim 15, **characterized** in that said mobile base station (BS) and transceiver (STCM2) are arranged to communicate with the cordless telecommunication system (CTMNW2) via a cellular network (GSMNW), particularly of the type GSM (Global System for Mobile Communication).



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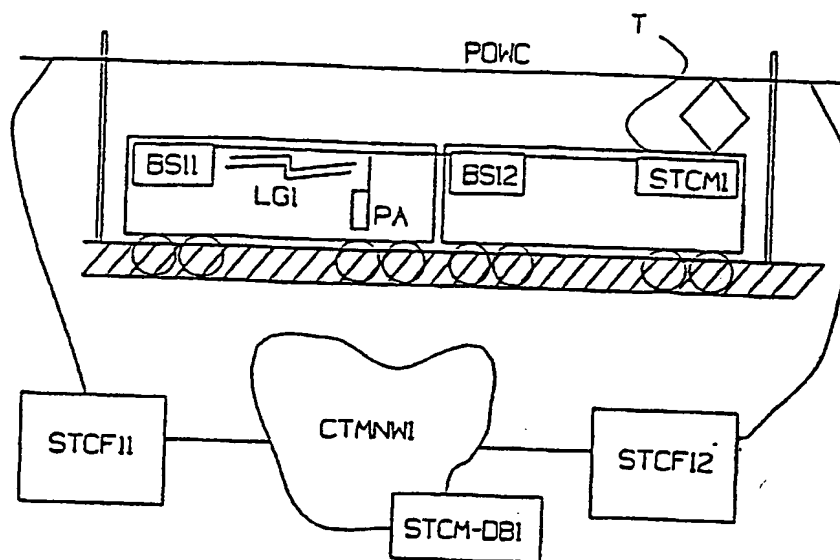


Fig. 1

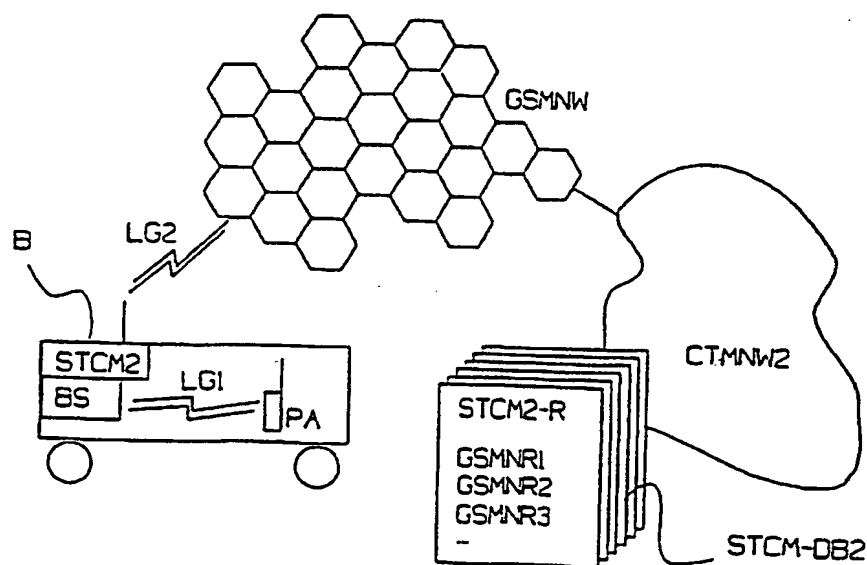


Fig. 2

SUBSTITUTE SHEET (RULE 26)

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/02013

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC6: H04B 7/26

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 19511520 A1 (ALCATEL SEL AG), 2 October 1996 (02.10.96) --	1-17
A	US 5384824 A (ALVESALO), 24 January 1995 (24.01.95) --	
A	US 5519761 A (GILHOUSEN), 21 May 1996 (21.05.96) --	
A	DE 4326523 A1 (SIEMENS AG), 9 February 1995 (09.02.95) -- -----	

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

29/04/98

International application No.

PCT/SE 97/02013

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